TORREYA

Vol. 8. June, 1908 No. 6.

BOTANY.*

By Herbert Maule Richards.

So much then for the purely theoretical side of botanical research of which I have presented a hasty glimpse. It is necessary before closing to make some reference to the utilitarian aspect; where and how botany directly serves the material needs of man. I hold it myself to be a matter of some pride that a science like botany with a side so purely theoretical and impractical can also lend itself to further, in such important ways as it does, the well-being of mankind, for in the direct application of botanical information to agricultural questions the ways and means of life may be ameliorated. Moreover, it is some of the most theoretical and recondite researches which have led to the most important practical results.

It is possible to consider only a few phases of the practical application of botany, and I will choose those which are not commonly recognized, and which require a high degree of special botanical training. The necessity of botanical knowledge in the use of plants and their products in the arts, or as drugs, is easily understood without further reference, and such uses do not necessarily involve any broad knowledge of plants as a whole.

It is quite different, however, in the matter of plant pathology, for here every channel of botanical information must be used to investigate plant ailments. Bacteria and parasitic fungi, which are themselves plants of a low order, are the cause of the bulk of plant diseases and for that reason the study of their life his-

* A lecture delivered at Columbia University in the Series of Science, Philosophy, and Art, December 4, 1907, copyrighted and published by the Columbia University Press, February, 1908, and reprinted by permission in Torreya, beginning with the March number.

[No. 5, Vol. 8, of Torreya, comprising pages 93–124, was issued May 19, 1908.

tories becomes a matter of no small importance. Then, too, the structure and habits of the host plants must be taken into consideration, for upon these may depend the means of prevention or of cure. The assembling of this information and its practical application to the question in hand devolve upon that type of botanist usually referred to as the mycologist, and despite many failures much that is of substantial practical use has been established. One of the earliest, if not the earliest, recorded instances of where a community has taken formal notice of the fungus pests of plants is found in the old Barberry Law passed by the province of Massachusetts before the Revolution. This called for the extirpation of the barberry which had been noticed by the colonists, without any knowledge on their part of the real cause, to be connected with the rust of their wheat fields. To-day we may not pass laws for the destruction of diseased plants, realizing perhaps the hopelessness of enforcing them, but we combat plant disease by the establishment of experiment stations devoted to the investigation of such matters.

As a result, there is now at the disposal of the agriculturalist much definite information of ways and means of diminishing or preventing loss through the destruction of crops by disease, losses which statistics show may amount to tens of millions annually; and while the study of the action of bacteria and fungi in the disease of plants is by no means complete, no one can deny the practical results which have been attained. In the more indefinite functional diseases of plants not ascribable to definite parasites, there is room for much more information, which will be forthcoming when our knowledge of nutrition physiology is more full. Already, however, we have suggestions as to the cause of the functional diseases which often appear where the same crop has been raised for many years in succession in the same spot, which bid fair to explain some important plant ailments that are at present not understood.

A more popularly interesting line of activity that has a practical bearing is found in plant breeding, which has recently been attracting wide attention. Plants are now bred systematically for desired characters, not always for increased yield only, but

also for such qualities as resistance to extremes of temperature, to lack of moisture in dry or semi-arid regions, to resistance towards specific diseases, and even for the more esthetic qualities of flavor or color. The old hit or miss methods of the improvement of strains by empirical rules of selection is passing away, and more and more scientific methods, based on the latest results of investigations of heredity and variation, are being employed. Passing over the older methods I will take up two very different types of plant breeding, both modern: one the strictly scientific, the other the intuitive.

The first method we owe largely to Nilsson, who introduced it at an experiment station in Sweden in connection with the cultivation of various cereal crops. It may be said that previous to his advent the older methods had been tried and abandoned as a failure. With his knowledge of what had been published about heredity and variation, Nilsson, after some preliminary experiments, arrived at the conclusion that no new, pure, or constant strains of wheat could be obtained unless the fruit of a single ear was bred separately, and thus he established what is known as the principle of breeding from the single ear and not from assorted lots of seed taken from many individuals. This breeding he continued, picking out any chance favorable ear which he could find, until he obtained many thousands of different forms owing to this multiplicity of strains mixed in the ordinary wheat. Of course some turned out to be mere bastard strains and only the ones which continued to breed true to character were kept. These constituted the new agricultural varieties—in reality elementary species and mutants — which, after severe tests had proved them suitable, were raised in marketable quantity for seed. The amount of work involved was enormous, the mere bookkeeping of the accurate pedigree record with notes on the life history of each form and its progeny was in itself no small matter. Besides the principle of single-ear breeding, Nilsson also established the fact that but a single selection alone is necessary to fix a new strain, provided the progeny of the chosen ear are carefully guarded from admixture with other forms. All this seems absurdly simple, and it is simple, so much so that it is quite possible of application by a

person of average intelligence who has had the proper instruction; but the important point is that it was discovered by the application of thoroughly scientific methods. Nilsson's principle is in very general application to-day and is being used to excellent effect in the improvement of Indian corn in the middle West.

Contrast with this the methods of Mr. Burbank, whose name is familiar to all. It is not that he should not be given the credit of having established new and useful strains of cultivated plants, or of having done some remarkable feats in the way of plant breeding; but it is that his methods are almost purely intuitive and would die with him, were his own records all that there was to be left behind, a striking difference from the mass of data accumulated by Nilsson. It is the rule of thumb method, picturesque but uncertain, as against the surer but less romantic practices of science.

The matter of general scientific agriculture opens an immense field in which I can call your attention to a few points only. The scientific care of our forests, for trees may be regarded as a crop and their culture agriculture, is a question to which we in this country are awakening none too soon. Forestry as practised in Europe, demanding as it does expert botanical knowledge, perhaps not by the foresters themselves but by those who direct their labors, has saved what were the fast diminishing wooded areas. There is need of haste with us for similar scientific treatment of the problem by men who are not simply woodsmen, but botanists as well.

The scientific rotation of crops, the use of fertilizers, and the study of the physical and chemical condition of the soil in connection with the living plants, involve questions which may mean the success or failure of much of our farming. These questions can only be settled by careful investigations which take into consideration the nature of the plants themselves as well as the physical conditions of their environment. Some may say that knowledge along this line has been satisfactorily handed down from father to son, that the farmer knows his business better than does the scientist, but it is a patent fact that this is not so. For instance, many a farm which has been damaged for a long period of years by the over-liming of the soil might have been spared had

the farmer of fifty years ago had the knowledge, which we now have, of the relation of lime to the other mineral substances needed by the plant, of when to apply it, and when to withhold it. It is the difference between merely empirical knowledge and that which is based on scientific principles.

When the contest comes between virgin soil and long tilled land, the latter, no matter how rich it may once have been, must needs be cultivated more intensively if it is to hold its own. Intensive cultivation requires the aid of special information and it is here that scientific agriculture comes into play. Few people realize that without artificial fertilizers, the direct outcome of highly theoretical work on the raw food stuffs of plants, much of the farming of to-day would be almost impossible. And the proper use of fertilizers is but one of many questions.

We are coming now in this country to a stage in its development when scientific agriculture must be seriously considered. Fortunately it is being so considered and the federal and state establishments devoted to the investigation of these agricultural questions may confidently be expected, I think, to help in the solving of the practical economic questions that must arise in the competition of our own agriculture with that of other lands. The way it must be done is by the introduction of improved methods based on carefully conducted scientific research, that often find their stimulus in the highly theoretical investigations of the pure scientist. Thus must the so-called impractical devotee of science come in contact with the practical man of affairs and furnish him knowledge that can be used for the benefit of all.

In this somewhat categorical fashion then, I have endeavored to present to you some of the content of the science of botany; that science which consists of the dismembering of flowers and the giving to them of long names. What its future will be is perhaps already indicated, but briefly you can see that it is in the direction of physiological advance, away from pure taxonomy and formal morphological conceptions towards the realm of function; away, too, from any segregation of the science from kindred fields towards a better understanding of the place of plants in the whole cosmic scheme.

Man's attitude towards the unknown — his philosophy in short — must influence his attitude towards botany as it will towards any science; and since philosophy, like other lines of intellectual activity, changes and progresses, man's attitude towards science is not a fixed or rigid one. But it is not likely that philosophy will ever tend to discourage investigation, and investigation is the keynote of scientific progress. Unquestionably, the world demands research, and any fact no matter how humble, if accurately established, helps on the cause. Perhaps the time will come when our knowledge of to-day will seem as crude as that of yesterday now seems to us. Let not that concern us, except to urge us to do what we may in hastening this time, knowing that that is where real progress lies, and knowing too that there is ample work that can and must be done.

A KEY TO THE WHITE AND BRIGHT-COLORED SESSILE POLYPOREAE OF TEMPERATE NORTH AMERICA—III*

BY WILLIAM A. MURRILL

K. THE SPECIES OF CORIOLUS

1. Tubes more or less entire, at least until the sporophore is quite old. 2
   Tubes soon breaking up into long irpiciform teeth. 19
2. Surface of pileus wholly or partly glabrous when mature or clothed only with inconspicuous hairs. 3
   Surface of pileus clothed entirely with a conspicuous, hairy covering. 17
3. Pileus not entirely glabrous at maturity. 4
   Pileus entirely glabrous at maturity. 13
4. Pileus marked at maturity with glabrous zones of a different color from the rest of the surface. 5
   Pileus not marked with glabrous zones, but nearly uniform in color and rarely shining. 10
5. Glabrous zones large, numerous, conspicuously and variously colored. *C. versicolor* (L.) Quél.
   Glabrous zones small and comparatively inconspicuous. 6
6. Surface villose between the zones, which are late in appearing; plants small, 1–2 cm. in diameter. *C. hirsutulus* (Schw.) Murrill

* This concludes the series of keys to the pileate species of polypores found in temperate North America. The resupinate species are more difficult, most of them requiring the facilities of a well-equipped herbarium, as well as considerable experience, for their proper determination.